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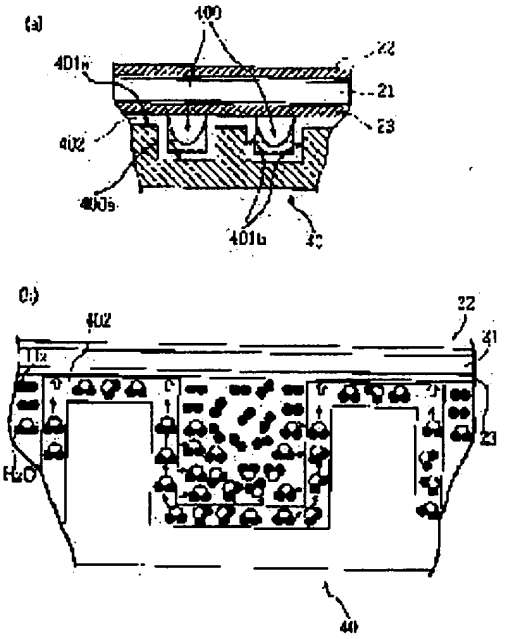
(54) SOLID POLYMER FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a solid polymer fuel cell which enables maintenance of the wet state of the whole solid polymer film, even if a molded article obtained by compression-molding a mixture of carbon and a resin is used as a rib- equipped plate.

SOLUTION: In this fuel cell, a water-holding layer 402 is formed on the side facing to a fuel electrode 23 of a rib-equipped plate 40 which forms channels 400, through which water, i.e., a wetting agent flows. The water-holding layer 402 is formed by spraying a mixture of resin dissolved in a solvent with carbon, then drying up it at a prescribed temperature. A wet-holding capacity per electrode action area of the wet-holding layer 402 is regulated to 0.002-0.035 g/cm2, preferably 0.01-0.03 g/cm2.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the polymer electrolyte fuel cell with which a generation of electrical energy is performed about a polymer electrolyte fuel cell, supplying a humidification agent to either [either / both or] fuel gas or an oxidizer.
[0002]
[Description of the Prior Art] The cel unit with which the cel which a fuel electrode is arranged on one field of a solid-state poly membrane, and it comes to match for the field of another side an oxidizing agent pole is the plate with a rib of the couple which two or more ribs keep predetermined spacing, and it comes to allot to parallel, and the polymer electrolyte fuel cell was pinched so that the rib concerned might counter is made into the basic structure, although put in practical use, the laminating of a majority of these cel units is carried out, and many are constituted.
[0003] And space formed between ****** ribs on the fuel electrode or the oxidizer pole is made into passage, hydrogen is supplied to the passage by the side of a fuel electrode as fuel gas at the time of operation, and the air (O2) as an oxidizer is supplied to the passage by the side of an oxidizer pole. At this time, in a fuel electrode, hydrogen is divided into a hydrogen ion (H+) and an electron (e-), and an electron (e-) flows to an external circuit toward an oxidizer pole through the solid-state poly membrane whose hydrogen ion (H+) is an electrolyte. On the other hand, oxygen (O2), the hydrogen ion (H+) to which it came from the fuel electrode, and the electron (e-) to which it came from the external circuit will react, water (H2O) will be generated on an oxidizer pole, and electrical energy will be obtained.
[0004] That a hydrogen ion passes a solid-state poly membrane, and goes to an oxidizer pole as described above It is because it has the property in which a solid-state poly membrane makes the hydrogen ion (H+ (XH2O)) of a hydration condition penetrate selectively (diffusion). This sake, The method which moisturizes a solid-state poly membrane by humidifying and supplying fuel gas from the former in order to make a solid-state poly membrane moisturize, Or by supplying [both] fuel gas and water to the passage by the side of a fuel electrode independently, and making it circulate, while performing efficiently the supply of fuel gas and the moisturization of a solid-state poly membrane to a fuel electrode, the method which can also perform cooling of a cell is adopted.
[0005] By the way, if a solid-state poly membrane dries that it is also partial, ionic permeability will fall, internal resistance will become large and generation efficiency will fall. Therefore, in order to fully demonstrate generation-of-electrical-energy capacity, it is necessary to also make the part which stands face to face against the rib end face of not only a part but the plate with a rib which stands face to face against the passage of the whole solid-state poly membrane, i.e., a solid-state poly membrane, humidify enough.
[0006] Then, conventionally, the carbon porous body is used for the above-mentioned plate with a rib, moisture will also fully permeate the part which stands face to face against the above-mentioned rib end face because of a porous body, and the whole solid-state poly membrane will be maintained by the damp or wet condition.
[0007]
[Problem(s) to be Solved by the Invention] However, since the process to which a plate with a rib is made by paper making of the carbon fiber chip being carried out first, and it hardening by phenol resin when producing a plate with a rib by the above-mentioned carbon porous body, and making a sheet, carrying out the laminating of this, calcinating the layered product concerned, and obtaining the plate of a carbon porous body, next generally carrying out cutting of this plate is taken, there is a problem that

mass production nature is bad and becomes cost high.
[0008] Then, raising the mass production nature is examined by fabricating and making a plate with a rib using metal mold from the admixture of carbon and resin. However, since the organization becomes precise, as for such mold goods, the part where the water repellence in the front face generally stands face to face against the rib end face of a solid-state poly membrane too by becoming high is no longer humidified fully.
[0009] Even if this invention uses a precise ingredient for a plate with a rib in view of the above-mentioned technical problem, it makes it a key objective to offer the polymer electrolyte fuel cell which can maintain the whole solid-state poly membrane to a damp or wet condition.
[0010]
[Means for Solving the Problem] In order to attain the above-mentioned object, the polymer electrolyte fuel cell concerning this invention It has the cel unit which turns the rib concerned inside and comes to carry out press pinching of the cel which arranged the electrode on both sides of an electrolyte membrane on the plate with a rib of a couple. It is the polymer electrolyte fuel cell with which passage is formed with said rib and electrode, and the humidification agent of said electrolyte membrane circulates to the passage by the side of the plate with a rib of one side or both: In the rib end face of the electrode of the plate with a rib with which a humidification agent circulates, and the front face which counters which presses an electrode at least, it is per electrode active area. Two or more 0.002 g/cm Two or less 0.035 g/cm It is characterized by forming the water retention layer which has water holding capacity.
[0011] Moreover, it replaces with said water retention layer, and is per electrode active area. Two or more 0.01 g/cm It is characterized by forming the water retention layer which has two or less 0.03 g/cm water holding capacity. Furthermore, said water retention layer is a porous layer which consists of resin mixing carbon, and the weight ratio of resin to carbon in the resin mixing carbon concerned More than 5 % It is characterized by being below 40 %.
[0012] Moreover, said water retention layer is a porous layer which consists of resin mixing carbon, and the weight ratio of resin to carbon in said resin mixing carbon More than 10 % It is characterized by being below 20 %. Moreover, the plate with a rib with which said humidification agent circulates is characterized by being formed with the non-calcinated Plastic solid or metal which consists of mixture of carbon and resin.
[0013] Moreover, the plate with a rib with which said humidification agent circulates is formed with the non-calcinated Plastic solid which consists of mixture of carbon and resin, and the weight ratio of resin to carbon More than 10 % It is characterized by being below 20 %. Moreover, the carbon which constitutes the plate with a rib with which said humidification agent circulates is characterized by being two or more sorts of mixture chosen from a graphite, expanded graphite, carbon black, or these.
[0014]
[Embodiment of the Invention] Drawing 1 is the assembly drawing of the cel unit 100 which constitutes the polymer electrolyte fuel cell 1 (only henceforth "a fuel cell 1") concerning the gestalt of this operation. The cel 20 which the cel unit 100 arranges the oxidizer pole 22 and a fuel electrode 23 on the one side side (drawing 1 top-face side) of the rectangle-like frame 10 at the solid-state poly membrane 21, and becomes as shown in this Fig., The passage substrate 30 which has the plate 310 with an oxidizing agent pole side rib with which two or more rib 311 -- was formed in parallel is inserted in, and it inserts in, and the plate 40 with a fuel electrode side rib of a frame 10 with which two or more rib 401 -- was formed in parallel on the other hand at the side (drawing 1 underside side) is crowded, and is constituted. In addition, in drawing 1 , since a fuel electrode 23 is in the tooth-back side of the solid-state poly membrane 21, it is expressed as the broken line.
[0015] It is held where press pinching of the cel 20 is carried out on the passage substrate 30 and the plate 40 with a fuel electrode side rib, and the oxidizing agent pole side channel 312 is formed in adjoining rib 311 -- and the space surrounded on the oxidizing agent pole 22, and the fuel electrode side channel 400 is formed in the space surrounded with the adjoining rib 401 and the fuel electrode 23. Air flows in the direction shown in oxidizing agent pole side channel 312 -- with the bold arrow of drawing 1 , fuel gas flows in the direction shown by the void arrow head of drawing 1 , and a generation of electrical energy is made by fuel electrode side channel 400 -- in a cel 20.
[0016] The reformed gas which comes to reform what uses hydrogen, such as hydrogen gas or natural gas, a propane, butane, and a methanol, as a principal component as fuel gas can be used. A frame 10 receives a rectangle-like board. In the center section of the fuel gas negotiation direction by the side of the one side (drawing 1 top-face side) The notch 101 for inserting in an above-mentioned cel 20 and the above-mentioned passage substrate 30 is formed. On the other hand, to a side (drawing 1 underside

side) The crevice 103 in which the plate 40 with a fuel electrode side rib is inserted is formed. Further in the center section of the notch 101 It is the configuration in which the aperture 102 was established so that the plate 40 with a fuel electrode side rib and a fuel electrode 23 can contact, and it is produced by injection molding plastic material.

[0017] Moreover, the manifold hole 112 and long hole 122 of a couple for supplying fuel gas to the manifold hole 111 and long hole 121 list of a couple for supplying the water (henceforth "humidification water") as a humidification agent of a solid-state poly membrane are established by the upper section to the fuel gas negotiation direction of a frame 10. The gas distribution substrate 12 to a long hole 122 with the water distribution substrate [broader than the long hole 121 concerned] 11 broader than the long hole 122 concerned is put on the long hole 121 through packing (un-illustrating), respectively, and 11b-- is established by both the substrates 11 and 12 over the longitudinal direction in two or more pore 11a-- and the location corresponding to said fuel electrode side channel 400 --. Therefore, the humidification water introduced through the manifold hole 111 will be distributed to each fuel electrode side channel 400 -- by pore 11a--, and the fuel gas introduced through the manifold hole 112 will be distributed to each fuel electrode side channel 400 -- by pore 11b--.

[0018] On the other hand, the manifold hole 114 and long hole 124 of a couple for discharging humidification water in the manifold hole 113 and long hole 123 list of a couple for discharging unreacted fuel gas are established by the downstream to the fuel gas negotiation direction of a frame 10. The well-known raw material 13 with the function which discharges gas selectively, for example, the gas transparency substrate which consists of water-repellent carbon paper, is put on the long hole 123 from fuel electrode side channel 400 --, and while it absorbs water you to be Sumiya and each channel retains the wastewater from fuel electrode side channel 400 -- to homogeneity, in order to drain smoothly, the well-known raw material 14, for example, the water absorption base material which consists of felt of polyester, is put on the long hole 124. Therefore, the unreacted fuel gas which has circulated fuel electrode side channel 400 -- results in the gas transparency substrate 13 through a long hole 123, and is sent out to the manifold hole 113, and the humidification water which has circulated fuel electrode side channel 400 -- results in the water absorption base material 14 through a long hole 124, and is sent out to the manifold hole 114.

[0019] The plate 310 with a rib inserts in, it is constituted [the frame 300 is crowded,], and, as for the passage substrate 30, the channel 302 for consisting of plastic material in the configuration in which, as for the frame 300 concerned, the aperture 303 was established in the center of a rectangle-like plate, and deriving the channel 301 and air for introducing air into a channel 312 from a channel 312 to the field (drawing 1 top face side) of an opposite hand with the oxidizing agent pole 22 side is formed.

[0020] In addition, a gasket 61 intervenes between a cel 20 and the passage substrate 30, and the gasket 62 intervenes between a cel 20 and a notch 101. The plate 40 with a fuel electrode side rib is carrying out the shape of a rectangle of smallness size a little than a frame 10, and two or more ribs 401 are formed in parallel. This plate 40 with a fuel electrode side rib consists of upper section 40b and downstream 40c which were installed from center-section 40a located in the center of the fuel gas negotiation direction, and this center-section 40a, and the height of a rib 401 is highly set up rather than upper section 40b and downstream 40c in center-section 40a. And high partial 401a of this rib 401 contacts the above-mentioned aperture 102 electrically with a fuel electrode 23 by **********.

[0021] The solid-state poly membrane 21 is a thin film which consists of perfluorocarbon sulfonic acid. The oxidizing agent pole 22 and a fuel electrode 23 are the layers of the predetermined thickness made from platinum (Pt) support carbon, and adhesion molding is carried out with the hotpress in the center section of the solid-state poly membrane 21. The plate 40,310 with a rib processes and manufactures the charge of an admixture of thermosetting resin and carbon by compression forming. With the gestalt of this operation, the FE Norian resin comparatively cheaper than other resin ingredients as thermosetting resin is used. Moreover, although it uses in order that carbon may give conductivity to a plate with a rib, any of a graphite, expanded graphite (for example, Hitachi Chemical CARBOFIT), and carbon black may be used for the class. Or two sorts which may mix and use these three sorts of all carbon, and are chosen from these as arbitration may be mixed and used.

[0022] 40% or less 5% or more of the weight ratio of resin to carbon is desirable, and it is 20% or less 10% or more preferably. If resin becomes 5% or less, it will be easy to generate a chip and a blow hole in the case of shaping, on the other hand, if resin becomes 40% or more, electrical conductivity will fall and the cell engine performance will fall, and it is from ****. Furthermore, it is because 10% or more fabrication at 20% or less is the optimal actually if the trouble on the above-mentioned manufacture and the fuel cell activity concerned is actually taken into consideration. In addition, in this example, the

mixed ratio with resin was made into carbon black:85wt% / phenol resin 15wt% (the weight ratio of resin to carbon = 17.6%) using carbon black.

[0023] Moreover, as shown in drawing 2 , the water retention layer 402 is formed in the near field in which the rib 401 of the plate 40 with a rib which forms the channel 400 to which humidification water circulates is formed. In addition, this Fig. is a sectional view which cut the plate 40 with a rib in the direction which intersects perpendicularly with the longitudinal direction of a rib. Moreover, although slight thickness of the water retention layer 402 is exaggerated and drawn in this Fig., as later mentioned to thickness T of the plate 40 with a rib being several mm, thickness t of the water retention layer 402 is several micrometers - hundreds of micrometers in extent.

[0024] As described above, since the plate 40,310 with a rib is manufactured by compression forming, its mass production nature is high and contributes it to the cost cut of the whole fuel cell. However, in order to pay ingredients to a mold and to fabricate in compression forming by heating, compression, and size enlargement, the porosity nature of carbon will be lost and it will be finished precisely. Therefore, the way things stand, although that front face comes to present water repellence, since the water retention layer 402 is formed, water retention and gas permeability will be secured about the plate 40 with a rib.

[0025] In addition, in the above, although the plate 40,310 with a rib was manufactured by compression forming using thermosetting resin, you may manufacture by the high method of injection molding mass production nature further not only using this but using thermoplastics. The water retention layer 402 is formed with the mixture (henceforth "resin mixing carbon") of resin and carbon, carries out spray spreading of what melted this resin mixing carbon with solvents, such as alcohol, on the front face of the plate 40 with a rib, and is made to fix it by desiccation processing after that. Desiccation is performed over about 1 hour under 200 degrees C. Thus, since it is made to solidify (without it to put a pressure) and the water retention layer 402 is formed only by merely drying resin mixing carbon, the porosity nature of carbon is not lost, but the water retention layer 402 concerned turns into a porous layer, and it comes to present absorptivity.

[0026] Although the class of the weight ratio of resin to carbon in resin mixing carbon or carbon is set up in the same range as the case of the plate 40,310 with a rib described above from the same reason It is the same as what uses a weight ratio and a carbon kind concerned of combination for the plate 40 with a rib, or by what is considered as the near thing, the water retention layer 402 becomes easy to get used with the plate 40 with a rib, and can enlarge the fixing force. In addition, in this example, they could be carbon black:85wt% / phenol resin 15wt% (the weight ratio of resin to carbon = 17.6%) like the above-mentioned plate with a rib.

[0027] As shown in drawing 3 , two or more sheet laminating of the cel unit 100 constituted as mentioned above is carried out (this example 65 sheets), the ends of the layered product concerned are pinched with the end plates 71 and 72 of a couple, and the fuel cell 1 is constituted. In this condition, it is open for free passage over said whole layered product, and the manifold hole 111,112,113,114 of each cel unit 100 forms the internal manifold.

[0028] And at the time of operation, it installs so that the negotiation way (oxidizing agent pole side channel 312) of air may be horizontally suitable, and air is sent into channel 301 -- by the fan who does not illustrate. The sent-in air supplies oxygen to an oxidizing agent pole, circulating oxidizing agent pole side channel 312 --, and is discharged out of a cell from a channel 302. On the other hand, humidification water is supplied to the internal manifold which consists of a manifold hole 111 with predetermined water pressure from a pump 3, and the hydrogen gas adjusted to the predetermined pressure through the regulator 5 from the hydrogen gas bomb 2 is supplied to it at the internal manifold which consists of a manifold hole 112.

[0029] The humidification water and hydrogen gas which were supplied are distributed to each cel unit 100, and as shown in drawing 4 , they are supplied to fuel electrode side channel 400 -- through the water distribution substrate 11 or the gas distribution substrate 12. In addition, drawing 4 (a) is the typical sectional view which cut the cel unit 100 of an assembly condition to the longitudinal direction of the rib 401 concerned so that the cross section of 401a parts of the rib 401 of the plate 40 with a fuel electrode side rib might appear, and drawing 4 (b) is the typical sectional view cut by the A-A line in this drawing (a).

[0030] Humidification of the solid-state poly membrane 21 is presented with some supplied humidification water, as mentioned above, a long hole 124 and the water absorption base material 14 are passed, the remainder consists of a manifold hole 114, and internal manifold ** of it is carried out, and it is discharged out of a cell. Moreover, while hydrogen gas circulates fuel electrode side channel 400 --,

as mentioned above, the unreacted hydrogen gas which remained without offering and presenting a generation of electrical energy passes a long hole 123 and the gas transparency substrate 13, and is discharged out of a cell through the internal manifold which consists of a manifold hole 113. In addition, from the internal manifold which consists of a manifold hole 113, it is mixed with hydrogen gas and some steam is discharged.

[0031] The humidification water discharged by drawing 3 from return and a fuel cell 1 and the water which the steam contained during exhaust air condensed are recovered by the liberating tank 4, it is cooled with a condensator 7 and the collected water is again supplied to a fuel cell 1 from a pump 3. The pressure of the unreacted hydrogen discharged is adjusted so that the hydrogen utilization factor in a fuel cell 1 may serve as a predetermined value with a regulator 6. In addition, since hydrogen gas is discharged in the condition of having dissociated with the water of a liquid, without going via a liberating tank 4, it collects as it is and it can also reuse the discharged hydrogen gas.

[0032] Drawing 5 (a) is the enlarged drawing of the B section in drawing 4 (b). In order that fuel electrode 23 front face may present water repellence, humidification water inclines toward the passage base 400a side, and flows, fuel electrode 23 part to which the steam generated from the humidification water currently held in the water retention layer of the steam generated from the humidification water concerned which is flowing and rib side-face 401b, or passage base 400a stands face to face against a channel 400 is passed, and humidity of the solid-state poly membrane 21 is carried out. Furthermore, since the water retention layer 402 is formed in the front face of the plate 40 with a rib, the water retention layer 402 concerned is permeated, it spreads also round the end-face 401a section of a rib 401, the steam generated from the water retention layer 402 of the end-face 401a section concerned also passes a fuel electrode 23, and humidification water carries out humidity of the solid-state poly membrane 21. That is, the solid-state poly membrane 21 is not only a part but the rib 401 facing a channel 400. -- As a result of also humidifying the part which faces the end face, humidity will be carried out over the whole.

[0033] In addition, although [this example] a water retention layer is prepared all over the side in which rib 401 -- of the plate 40 with a rib is prepared, you may make it only rib side-face 401b -- prepare the gestalt which prepares a water retention layer in the front face of the plate 40 with a rib only in rib end-face 401a and passage base 400a with rib end-face 401a-- only not only as for this but rib end-face 401a --. Namely, although the above-mentioned predetermined effectiveness will be acquired at least if the water retention layer is prepared in rib end-face 401a Not only by rib end-face 401a but by rib side-face 401b and extending with base 400a of a channel like this example further, as shown in drawing 5 (b), the water absorption area of a water retention layer will increase, and the water supply amounts to the water retention layer of the rib end-face 401a section will increase the part in which a water retention layer is prepared.

[0034] Here, the invention-in-this-application person showed clearly that the water capacity in the above-mentioned water retention layer, i.e., the water holding capacity of a water retention layer, is too small by the experiment 1 which describes in a header that inconvenience arises even if too large, of course, and describes the proper range below. In addition, water holding capacity was expressed with the amount which converted into per electrode active area (here per active area of a fuel electrode) the amount of water which can hold a water retention layer, and the unit was made into [g/cm2] and measured in the following procedures.

[0035] ** Make the plate with a fuel electrode side rib with which the water retention layer was prepared first immersed in 80-degree C ion exchange water for about 1 hour.

** Wipe off lightly the front face of the plate with a rib made above-mentioned immersed for 1 hour with a nonwoven fabric (the product made from KURESHIA, Inc., trade name "KIMUTAORU"), and measure the weight of the plate with a rib after wiping.

[0036] ** Next, measure the weight after drying a plate with a rib with a 80-degree C thermostat for about 1 hour.

** It is electrode active area (in this example, it ** by 2 100cm and water holding capacity [g/cm2] is acquired.) about the difference of the weight measured by the above-mentioned ** and **.

By changing the thickness of a water retention layer, the experiment 1 changed water holding capacity and measured the water-holding-capacity-cel voltage characteristic under the following actuation conditions (1). in addition, the hydrogen gas bomb 2 shown in drawing 3 in experiment 1 -- replacing with -- a reformer -- using -- as fuel gas -- hydrogen -- we decided to supply rich reformed gas.

(1) 電流密度　　：0．4A／cm²
燃料ガス　　：80%H_2／20%CO_2
水素利用率　　：70%
酸化剤利用率　　：20%
電池温度（中央）：80℃

Drawing 6 is property drawing showing this measurement result. When water holding capacity becomes out of range [0.002-0.035 [g/cm2]] from this property drawing, it turns out that a cel electrical potential difference falls from the electrical-potential-difference value 0.6 [V] usually demanded as a fuel cell. An electrode interface will get wet, it will become easy to generate water plugging in a ** channel, gaseous diffusion nature will fall, and this will be considered because it will be in a local lack-of-gasoline condition, if osmosis of the water to the contact part of a rib end face and an electrode will become difficult, humidity of the solid-state poly membrane will not be carried out over the whole, if water holding capacity becomes less than 0.002, and water holding capacity exceeds 0.035 on the other hand. Moreover, this property drawing shows that water holding capacity is stabilized by the cel electrical potential difference with about 0.7 [V] in 0.01-0.03 [g/cm2]. The water holding capacity of the above result to a water retention layer is two or more 0.002 g/cm. Two or less 0.035 g/cm is two or more 0.01 g/cm desirable still more preferably. It is two or less 0.03 g/cm. In addition, in this experiment, the thickness of the water retention layer corresponding to water-holding-capacity 0.002 g/cm2 - 0.035 g/cm2 was 10 micrometers - 100 micrometers, and the thickness of the water retention layer corresponding to water-holding-capacity 0.01 g/cm2 - 0.03 g/cm2 was 5 micrometers - 200 micrometers.

[0037] In addition, the water holding capacity of a water retention layer can change the class of carbon in addition to the approach of changing the thickness of a water retention layer as mentioned above, can change the class of ostomy agent, and its appending rate, or can adjust them also according to the gestalt which prepares a water retention layer in a plate front face with a rib. Although each data are not shown, the almost same result is obtained also by these adjustment approaches.
[0038] Moreover, the fuel cell (henceforth a "comparison cell") which does not have a water retention layer was produced as an example of a comparison of the fuel cell 1 concerning the gestalt of the above-mentioned implementation. The specification of a fuel cell 1 and a comparison cell is shown in a table 1.

[0039]
[A table 1]

セル仕様	燃料電池1	比較電池
電極作用面積	100cm²	←
電解質膜	パーフルオロカーボンスルホン酸膜	←
燃料極	Pt担持カーボン	←
酸化剤極	Pt担持カーボン	←
リブ付プレート	圧縮成形品 (カーボンブラック85wt%/フェノール樹脂15wt%)	←
燃料極側リブ付プレートに対する保水層	組成:カーボンブラック85wt%/フェノール樹脂15wt% 保水力0.025g/cm²(厚み20μm±5μm)	なし

[0040] That is, the difference between a fuel cell 1 and a comparison cell is only the existence of a water retention layer. First, the experiment 2 which measures the current density-cel voltage characteristic was conducted about the fuel cell 1 and the comparison cell. The actuation conditions (2) are as follows.
（2）燃料ガス　　：H_2
酸化剤　　：空気
水素利用率　　：70%
酸化剤利用率　　：20%
電池温度（中央）：約70℃

Drawing 7 is drawing showing the current density-cel voltage characteristic which it is as a result of experiment 2. From this property drawing, both a fuel cell 1 and a comparison cell are understood that there are few rates that a cel electrical potential difference falls [the direction of a fuel cell 1], although the cel electrical potential difference is falling as current density becomes large. By the comparison cell, since ****** is not prepared, the wettability of the whole solid-state macromolecule is bad, therefore ionic permeability falls, and this is considered to be because for internal resistance to be that much large.

[0041] Next, the experiment 3 which measures aging of an average cel electrical potential difference was conducted using the fuel cell 1 and the comparison cell. The actuation conditions (3) are as follows.

(3) 電流密度：0．4A／cm²
燃料ガス　：H_2
水素利用率　：７０％
酸化剤利用率　：２０％
電池温度（中央）：約７０℃

Drawing 8 is property drawing showing aging of the cel electrical potential difference which it is as a result of experiment 3. As for a comparison cell, this property drawing shows that a cel electrical potential difference tends to fall with time to the cel electrical potential difference of a fuel cell 1 almost not having a change with time. This is considered to be based on the following reasons. That is, in order that the passage (equivalent (refer to drawing 5 (a)) to channel 400 of fuel cell 1) front face of the water of a comparison cell may present water repellence, the circulating water tends to become the shape of so-called ball. Therefore, gaseous diffusion nature falls in the part which water plugging tended to generate and water plugging generated. And once water plugging occurs, it will not be canceled easily, but it is thought that it is for this water plugging part to increase and for the local lack-of-gasoline condition part to increase gradually with the passage of time. On the other hand, it is thought that the passage front face of the water of a fuel cell 1 is hard to generate water plugging since water does not become ball-like as it described above, since it was covered in the water retention layer.

[0042] As mentioned above, although the polymer electrolyte fuel cell of this invention has been explained based on the gestalt of operation, this invention is natural, for example, even if it is as follows, it is good. [of not being restricted to the gestalt of the above-mentioned implementation]

(1) After humidifying fuel gas with a humidifier, you may make it send in with the gestalt of the above-mentioned implementation, although water was sent into the channel by the side of a fuel electrode as a humidification agent.

(2) Although the humidification agent was sent only into the channel by the side of a fuel electrode, you may make it send a humidification agent into the channel by the side of an oxidizing agent pole, and may make it send a humidification agent into both channels further with the gestalt of the above-mentioned implementation. However, suppose at the plate with a rib which forms the channel of the side which sends in a humidification agent that a water retention layer is formed the same with having mentioned above.

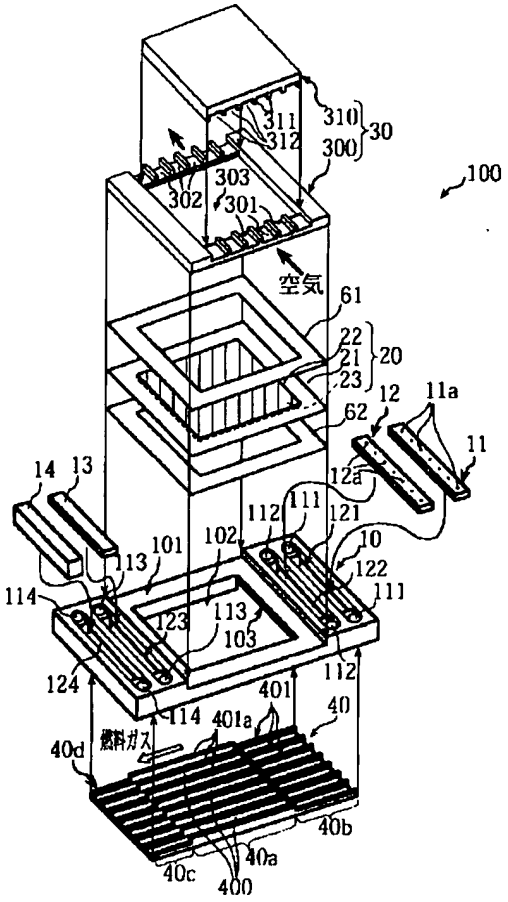
[0043] Furthermore, you may make it form a water retention layer not only in the plate with a rib which forms the channel of the side which sends in a humidification agent but in the plate with a rib of the side which does not send in a humidification agent. That is, if the gestalt of the above-mentioned implementation is told to an example, you may make it form a water retention layer also in a plate with an oxidizing agent pole side rib. By doing in this way, the generation water generated by the oxidizer pole side will also be held in this water retention layer, the wettability of a solid-state poly membrane increases and improvement in the cell engine performance is achieved further. In addition, conditions required of the water retention layer concerned, such as range which forms a water retention layer in the plate with a rib of the side which does not send in a humidification agent, and its water holding capacity, are the same as the conditions required of the water retention layer of the plate with a rib of the side which sends in the humidification agent explained with the gestalt of the above-mentioned implementation.

(3) Although the plate with which the rib was formed in one side was used with the gestalt of the above-mentioned implementation, it cannot be overemphasized that this invention can be applied also to the fuel cell using the plate with which the rib was formed in the both sides. That is, you may be a fuel cell using the plate with a rib which formed the plate with a rib by the side of a fuel electrode, and the plate

with a rib by the side of an oxidizing agent pole in one.
(4) Although the plate with a rib was formed with the mixture of carbon and resin, you may make it produce with extruding, die casting, etc. with the gestalt of the above-mentioned implementation using a metallic material.
(5) Although what melted resin mixing carbon with solvents, such as alcohol, was applied to the plate front face with a rib by the spray on the occasion of formation of a water retention layer in the gestalt of the above-mentioned implementation, you may make it apply by not only this but the brush, the spatula, or screen-stencil.
(6) In order to make porosity nature increase further, you may make it use an ostomy agent further with the gestalt of the above-mentioned implementation, although the water retention layer was formed with resin mixing carbon. The example using an ostomy agent is described in two and the following.
[0044] ** Although resin mixing carbon was melted with solvents, such as alcohol, mix to inside what made transition metals or calcium carbonates, such as zinc, lead, iron, copper, or nickel, etc. the shape of powder as an ostomy agent. And this mixed thing is applied to the front face of a plate with a rib, and is once dried. Then, the plate with a rib concerned is immersed in a hydrochloric acid, a nitric acid, or a sulfuric acid, said ostomy agent is dissolved, and it is made to dry again. By doing in this way, the part where the dissolved ostomy agent existed becomes a cavity, and the porosity nature of a water retention layer increases.
[0045] ** Although resin mixing carbon was melted with solvents, such as alcohol, make it the shape of a paste by mixing kerosine with the powder of the ammonium hydrogencarbonate as an ostomy agent to inside, and filtering this to it. After it applies to the front face of a plate with a rib what became the shape of this paste and it carries out predrying at low temperature, actual desiccation is carried out under 200 degrees C. By doing in this way, an ammonium hydrogencarbonate volatilizes, the part where the ammonium hydrogencarbonate concerned existed becomes a cavity, and the porosity nature of a water retention layer increases. In addition, carrying out actual desiccation at 200 degrees C volatilizes alcohol thoroughly, and although it is for removing from a water retention layer as much as possible, if an ammonium hydrogencarbonate is only volatilized, and it is made to dry under about 80 degrees C, it is sufficient for it.
[0046]
[Effect of the Invention] As explained above, according to the polymer electrolyte fuel cell concerning this invention A water retention layer is formed in the rib end face of the plate with a rib with which a humidification agent circulates which presses an electrode at least. The water retention layer concerned Per electrode active area Two or more 0.002 g/cm Since it has two or less 0.035 g/cm water holding capacity Even if it forms a plate with a rib with a precise ingredient, a humidification agent spreads to the rib end-face section through the water retention layer concerned, humidity of the whole electrolyte membrane will be carried out, and the stable cel electrical potential difference can be obtained. Since in other words it becomes possible to produce a plate with a rib with compression molding according to this invention, mass production nature becomes high and can aim at a cost cut.
[0047] Furthermore, it is the water holding capacity of a water retention layer per electrode active area. Two or more 0.01 g/cm It becomes possible to obtain the cel electrical potential difference stabilized further by making it two or less 0.03 g/cm.

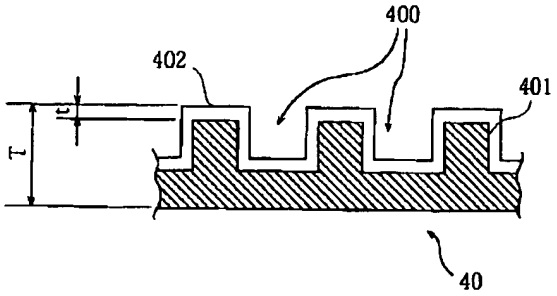
[Translation done.]

Drawing selection drawing 1



[Translation done.]

Drawing selection drawing 2



[Translation done.]